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PNEUMATIC LOAD COMPENSATING OR CONTROLLING SYSTEM

Invention Abstract

The invention pertains to a pneumatic system for applying a constant predetermined force to a load.

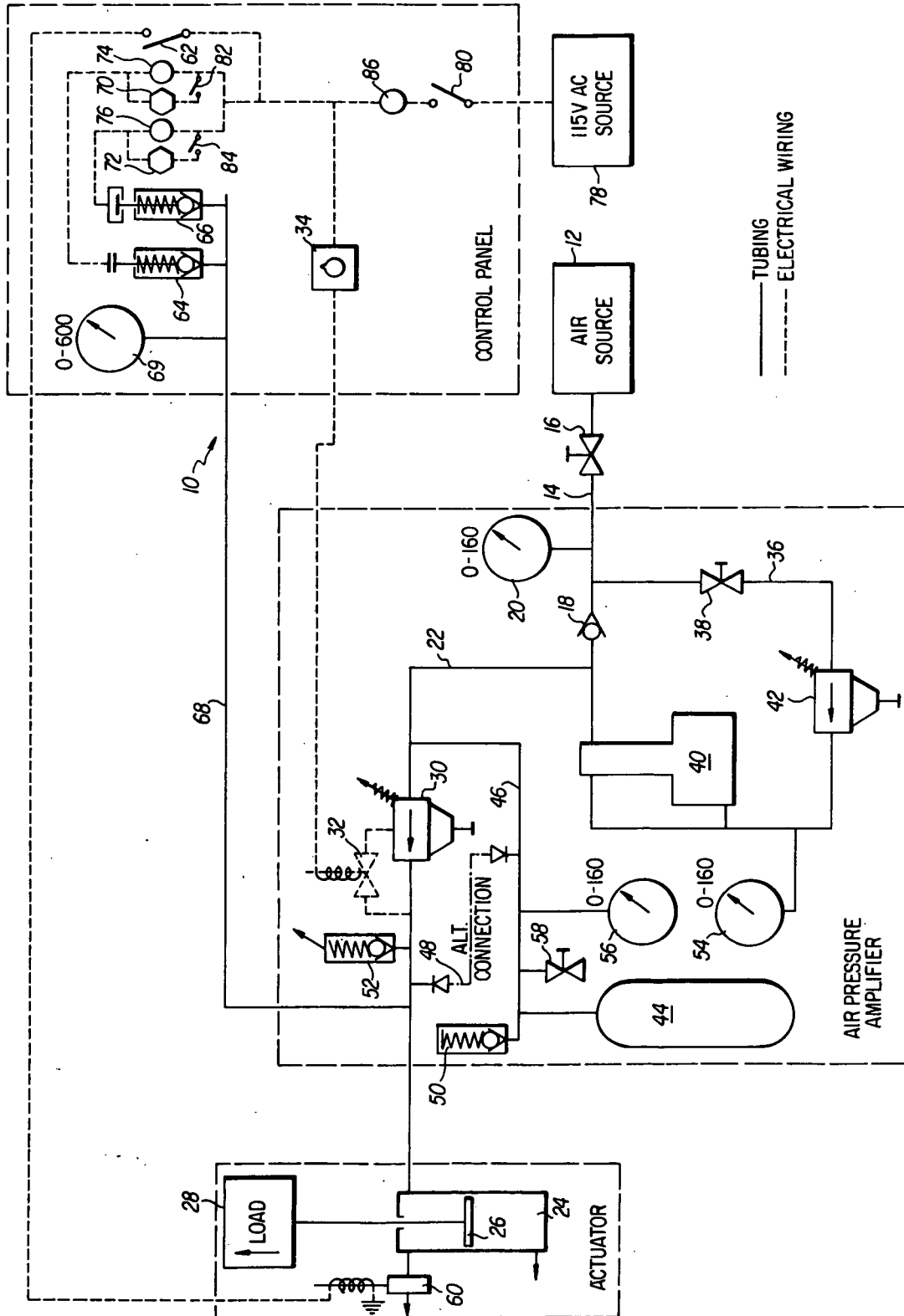
In accordance with the invention an air source 12 is fed through valves 16 and 38 to pressure regulator 42 which is adjusted to any desired pressure below that of the air source. The output of regulator 42 is amplified by an air-driven amplifier 40 which may, for example, have a gain of five. The amplifier requires no external power source whatsoever. The amplified air pressure is passed through regulator 30, the pressure setting of which is remotely controlled by knob 34 of the control panel. The output of regulator 30 is fluidically coupled to one-way pneumatic actuator 24 which applies a force to mechanically-coupled load 28. As regulator 30 is adjusted, the force applied to load 28 is varied. The air pressure at actuator 24 is monitored on gage 69. Pressure switches 64 and 66 control aural alarms. An alarm is sounded either when the actuator pressure reaches a preset minimum or maximum. An accumulator 44 serves as a means of reducing or compensating for any shocks which may be impressed upon actuator 24 as a result of load variations. In addition, the accumulator also serves as an auxiliary source of high pressure fluid to be conducted to the actuator in the instance that a system failure should occur. In one model of the invention wherein a 100 psi air source (12) and five-inch diameter actuator cylinder were employed, a 9900-pound force was developed at load 28.

While the prior art includes fluid control systems which may be utilized in conjunction with one-way actuators so as to, for example, apply a high concentrated output load through means of the actuator, such systems have heretofore invariably been hydraulic pressure control systems which normally require the employment of sophisticated electrically operated and controlled servo valves for proper control of the hydraulic fluid within the system circuitry. The subject invention uses as an input a low-pressure air source of the variety which is readily available in many repair shops, garages, etc.

Inventor: James R. Rogers

Employer: NASA - Ames Research Center

Evaluator: Shizuo Doiguchi



TITLE OF THE INVENTION:

PNEUMATIC LOAD COMPENSATING OR CONTROLLING SYSTEM

ABSTRACT OF THE DISCLOSURE

A pneumatic load compensating or controlling system for restraining a load with a predetermined force or applying a predetermined force to the load includes a source of pressurized air, a one-way pneumatic actuator operatively connected to a load, and a fluid conduit fluidically connecting the actuator with the source of pressurized air. The actuator may be of the piston and cylinder type, and the end of the fluid conduit associated therewith may be connected to the upper or lower portion of the cylinder whereby the actuator may alternatively and selectively restrain the load with a predetermined force or apply a predetermined force to the load. Pressure regulators are included within the system for variably selectively adjusting the pressurized fluid to predetermined values as desired or required, and a pressure amplifier may also be included within the system for multiplying the pressurized values so as to achieve greater load forces. An accumulator is incorporated within the system as a failsafe operating mechanism, and visual and aural alarm devices, operatively associated with pressure detecting apparatus, readily indicate the proper or improper functioning of the system.

RIGHTS OF THE GOVERNMENT

The invention described herein was made by an employee of the United States Government and may be manufactured and used, by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

Field of the Invention:

The present invention relates generally to pneumatic control systems and more particularly to an improved pneumatic control system which is particularly adaptable for holding or restraining, or alternatively, applying, a high concentrated load with respect to a one-way actuator or actuating mechanism.

Description of the Prior Art:

Prior art pneumatic control devices are of course known, such as for example, that disclosed within U.S. Patent 3,468,383, however such exemplary systems are not capable of one-way actuation and the application, or drawing, of a predetermined load, and the maintenance of the same.

In addition, while the prior art also includes fluid control systems which may be utilized in conjunction with one-way actuators or actuating mechanisms so as to, for example, apply a high concentrated output load through means of the actuator, such fluid systems have heretofore invariably been hydraulic pressure control systems which normally require the employment of sophisticated electrically operated and controlled servo valves for proper control and output of the hydraulic fluid within the system circuitry.

Consequently, such systems characteristically exhibit several serious drawbacks and disadvantages which militate against their commercial and industrial use and application, particularly, the fact that as such systems require their own hydraulic pressure sources, permanent installations are usually required. In addition, in light of such permanency, as well as the sophisticated components employed, the systems are quite expensive to fabricate, and still further, as a result of the level of sophistication normally attendant

such installations, there is a greater probability of a system failure or breakdown, whereby extensive damage could be impressed upon the entire system as a result of such failure of the control system to properly control the load and contamination of the installation area could be experienced due to hydraulic leakage.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved load control system.

Another object of the present invention is to provide an improved load control system which overcomes the aforementioned drawbacks of conventional control systems.

Still another object of the present invention is to provide an improved load control system which is pneumatically controlled.

Yet another object of the present invention is to provide an improved load control system which is essentially portable, readily connectable to any source of compressed air, and consequently does not require its own pressure source.

Yet still another object of the present invention is to provide an improved load control system which exhibits a considerable degree of simplicity and is quite easy to manufacture and install.

A further object of the present invention is to provide an improved load control system which does not require the use of sophisticated control devices, yet is capable of performing equally as well as prior art hydraulic control systems which normally utilize such control devices.

A still further object of the present invention is to provide an improved load control system which is substantially less expensive to fabricate than prior art control systems.

The foregoing and other objectives are achieved according to the present invention through the provision of a load control system which includes a source

of pressurized air, a one-way pneumatic actuator operatively connected to a load, and a fluid conduit fluidically connecting the actuator with the source of pressurized air. The actuator may be of the piston and cylinder type, and the end of the fluid conduit associated therewith may be connected to the upper or lower portion of the cylinder whereby the actuator may alternatively restrain the load with a particular force or apply a particular force to the load.

Pressure regulators are also included within the system for supplying pressurized fluid having a predetermined value, as desired or required, and a pressure amplifier may also be included within the circuit for multiplying the pressure as desired or required in excess of the predetermined value. An accumulator is incorporated within the system as a failsafe operating mechanism and visual and aural alarm means, associated with pressure detecting apparatus, readily indicate the proper or improper functioning of the system.

BRIEF DESCRIPTION OF THE DRAWING

Various other objects, features, and attendant advantages of the present invention will be more fully appreciated as the same becomes better understood from the following detailed description when considered in connection with the accompanying drawing, wherein:

The SOLE FIGURE is a schematic diagram of a load control system constructed in accordance with the present invention and showing its cooperative parts.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring now to the drawing, there is shown a load control system, generally indicated by the reference character 10, which comprises a source 12 of compressed air, the pressure valve of which may be within the range of 90-125 psi, fluidically connected to a fluid conduit 14. An air flow control valve 16 is disposed within conduit 14 and downstream of source 12 and in this manner, valve 16 controls the supply of pressurized air into the system 10.

A check valve 18 is also disposed within conduit 14, and downstream of valve 16, so as to prevent backflow of fluid within conduit 14, and a pressure gauge 20 may likewise be disposed within conduit 14 and interposed between valves 16 and 18 so as to visually indicate the pressure value of the pressurized air being admitted into the system.

Another fluid conduit 22 is fluidically connected at one end thereof with fluid conduit 14, while the other end of conduit 22 is likewise fluidically connected to the upper portion of a one-way pneumatic actuator 24 of the piston and cylinder type, the piston 26 of actuator 24 being operatively connected with a load 28, the relative position of which is to be controlled by the system 10, and more particularly, by means of actuator 24. While conduit 22 has been shown to be fluidically connected with the upper portion of actuator 24, whereby a particular load 28 may be retained or restrained within a particular position, conduit 22 may likewise be fluidically connected to the bottom portion of actuator 24 whereby a particularly valued force may be applied to the load.

A Norgren pressure regulator 30 is disposed within fluid conduit 22 at a position upstream of actuator 24 so as to regulate the value of the pressurized air being conducted to actuator 24, and in turn, the output force thereof which is applied to load 28, regulator 30 being of the type which may be variably adjusted by means of an electrically controlled, motor-driven valve 32, which is interposed between and operatively associated with regulator 30, and a remotely controlled, reversible polarity, rotary switch 34, the latter of which energizes and actuates valve 32 when it is desired to attain a particular pressurized output from regulator 30.

An additional fluid conduit 36, having a closed loop configuration, is fluidically connected to and interposed between conduits 14 and 22, and an air flow control valve 38, similar to valve 16, is likewise disposed within

conduit 36 so as to control the admission of the pressurized air into conduit 36 from air source 12. An air driven, air booster, amplifier, or intensifier 40, which may, for example, be procured from the Haskel Engineering & Supply Co., is disposed within conduit 36 at a position downstream of valve 38 and upstream of the junction between conduits 36 and 22, and a pressure regulator 42, similar to regulator 30, is also disposed within conduit 36 so as to be interposed between valve 38 and amplifier 40.

The regulator 42 is adjusted so that the output pressure thereof does not exceed the pressure value of source 12, and the regulator output pressure may then be conducted into amplifier 40 so as to be amplified in value in accordance with the rated amplification proportion or ratio of the particular amplifier employed. Amplifiers normally have amplification ratios of 2: 1, 5: 1, 15: 1, and 30: 1, and it is sufficient for the purposes of the present invention that amplifier 40 have a ratio of, for example, 5: 1. It is thus apparent that depending upon the particular load desired or required to be impressed upon actuator 24, the pressurized air supplied to actuator 24 may have various values which are dependent upon the particular actuation or employment of the air pressure regulators 30 and 42, as well as amplifier 40. For example, if loads within the range of 0-2500 lbs are required or desired to be impressed upon actuator 24, valve 38 may remain closed whereby the amplifier circuit is by-passed and regulator 30 is suitably adjusted, while if loads in excess of 2500 lbs are required or desired to be impressed upon actuator 24, valve 38 is opened, pressure regulator 42, as well as regulator 30, is suitably adjusted, and the pressurized air, as also amplified by means of amplifier 40, is supplied to actuator 24.

10 An accumulator 44, for storing highly pressurized air, is always in fluidic communication with conduit 22 through means of a fluid conduit 46, and in this manner, the accumulator serves as a means of reducing or compensating for any shocks which may be impressed upon actuator 24 as a result of the load differentials experienced by actuator 24 when the position of the same, relative to the load, is adjusted. In addition, the accumulator also serves as an auxiliary source of high pressure fluid to be conducted to the actuator in the instance that a system failure should occur. As shown in the drawing, accumulator conduit 46 is connected to conduit 22 at a position upstream of regulator 22, however, an additional fluid conduit 48 may be provided so as to fluidically connect accumulator conduit 46 with conduit 22 at a position downstream of regulator 30, and in this manner, if a system failure should occur anywhere upstream of the junction between conduits 48 and 22, such as for example, within regulator 30, conduits 22 and 14, valves 16 and 18, or source 12, the high pressure air within accumulator 44 may nevertheless be supplied to actuator 24 whereby the operational integrity of the system is preserved.

15 It is apparent that suitable means, not shown, are provided for re-supplying the high pressurized air to accumulator 44, and it is further apparent that while not illustrated, accumulator 44 could also be fluidically connected to conduit 36, at a suitable location thereof, so as to advantageously provide the system with an amplified source of pressurized air in the event of a system failure which normally prevents the benefits of the amplifier circuit from being realized.

20 In order to protect the system, and the various components thereof, from excessive pressures, pressure relief valves 50 and 52 are disposed within fluid conduits 46 and 22 so as to be respectively operatively associated with accumulator 44 and air pressure regulator 30, and pressure gauges 54 and 56,

which may be similar to gauge 20, may be disposed within conduits 36 and 46, respectively, in order to visually indicate the pressure values of the fluid flowing within the respectively noted conduits. In addition, a valve 58, which may be similar to valves 16 and 38, is disposed within fluid conduit 46 so as to be capable of bleeding conduit 46 and accumulator 44 when, for example, maintenance upon the latter is desired to be performed, and another valve 60, which is a solenoid-type valve remotely controllable through means of an ON-OFF switch 62, is similarly provided for facilitating dumping of the fluid pressure within actuator 24 so as to release the same and the force thereof impressed upon load 28.

The control system 10 also includes suitable alarm apparatus for visually and aurally indicating proper or improper operation of the system, and such apparatus may, for example, include pressure switches 64 and 66 which are fluidically connected to fluid conduit 22 through means of a fluid conduit 68, a pressure gauge 69, calibrated in lbs-force, being incorporated within conduit 68. As switch 64 is normally open, while switch 66 is normally closed, extreme or excessively high or low pressure values may be detected by means of such switches which are, in turn, respectively electrically connected to aural alarm buzzers 70 and 72, as well as to visual alarm lights 74 and 76, and in this manner, the detection of abnormal pressures within conduit 22 may be readily aurally and visually indicated. Electrical power may be provided for the system by means of a 115 VAC source 78, and suitable ON-OFF switches 80, and 82 and 84, which are similar to switch 62, may be provided for controlling the electrical power from source 78 to the system, as well as to the alarm circuits, respectively. An additional visual indicating light 86 is also provided in series with switch 80 for visually indicating the supply of electrical power into the system.

Thus, it may be seen that the control system of the present invention has important advantages over the known prior art system in that the system is portable and readily connectable to any source of pressurized air, and is quite simple in structure and inexpensive to manufacture and fabricate. The control panel, air pressure amplifier, and actuator assemblies may be assembled in a single module or the assemblies may be remotely spaced from each other. Through the use of simple regulators and amplifiers, various pressure values and forces may be impressed upon a load so as to restrain or actuate the same with a high concentrated load. It has in fact been experienced that with the employment of an actuator cylinder having a five-inch diameter, and wherein the fluid pressure was 100 psi, a 9900 pound load was able to be applied, and higher loads are of course possible in light of the foregoing. The present invention may thus be used in shops, plants, testing labs, or the like, in order to apply loads, stamp parts, or in fact, to be used under any conditions where one-way hydraulic cylinders are conventionally utilized.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. For example, the system of the present invention can be altered in many ways so as to meet various load requirements, such as for example, the fact that amplifiers can be installed in parallel so as to provide for high volume changes, and it should be noted that the amplifiers have their own check valves which allow the air to be automatically pumped up so as to meet air volume demands. The pressure regulators can also be either higher or lower rated so as to meet higher or lower pressure requirements, and it should also be noted in conjunction therewith, that the regulators may have internal bleeds so as to bleed off pressure when the output exceeds the regulator setting. A rotary actuator may also be used if constant torque is required. It is to be understood therefore that within the scope of the appended claims the present invention may be practiced otherwise than as specifically described herein.